PB90-234121

Final Treatment Standards for Nonwastewater and Wastewater Forms of K100. Volume 12

Versar, Inc., Springfield, VA

Prepared for:

Environmental Protection Agency, Washington, DC

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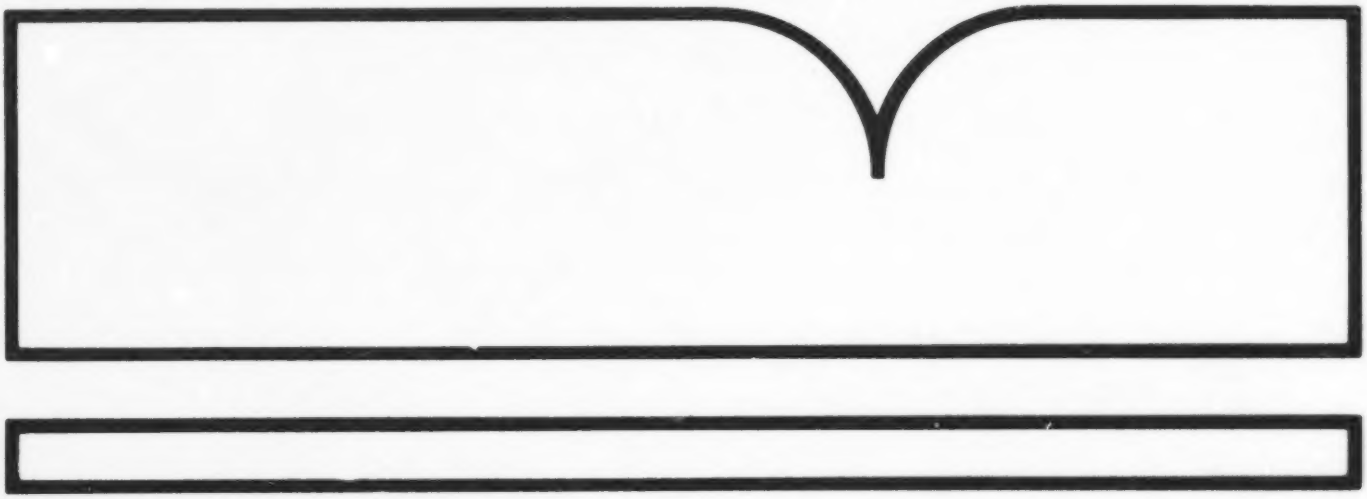

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This background document provides the Agency's technical support and rationale for the development of treatment standards for the constituents to be regulated for the above-mentioned wastes.

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PB90-234121

MEMORANDUM

TO: Monica Chatmon-McEaddy

cc: J. Strauss
S. Shwartz
5254 File

FROM: Amanjit S. Paintal

DATE: May 8, 1989

SUBJECT: Final Treatment Standards for Nonwastewater and Wastewater Forms of K100

This memorandum presents the technical support and rationale for the development of treatment standards for nonwastewater and wastewater forms of K100.

INTRODUCTION

According to 40 CFR Part 261.32 (hazardous wastes from specific sources), waste code K100 is listed as waste leaching solution from acid leaching of emission control dust/sludge from secondary lead smelting. Treatment standards for K100 wastes were originally scheduled to be promulgated as part of the Third Third rulemaking. However, a treatment standard of "No Land Disposal Based on No Generation" for K100 nonwastewaters was promulgated on August 8, 1988, and was subsequently revised on May 1, 1989, (54 FR 18836) to be applicable only to "Nonwastewater forms of these wastes generated by the process described in the listing description and disposed after August 17, 1988, and not generated in the course of treating wastewater forms of these wastes [Based on No Generation]."

In the proposal for the Second Third Wastes (54 FR 1056, January 11, 1989), EPA stated its intention to develop concentration-based treatment standards for all forms of K100 prior to May 8, 1990, and has since

decided to the promulgated to revoke treatment standard of "No Land Disposal Based on No Generation" for K100 nonwastewaters. EPA prefers to set concentration-based treatment standards in lieu of this standard and is promulgating these for K100 nonwastewaters.

Concentration-based treatment standards for all forms of K100 are promulgated based on the transfer of performance data from other hazardous wastes known to be similar in chemical and physical form to K100 wastes.

INDUSTRY AFFECTED

In the manufacture of refined lead, lead oxide, antimonal lead, and lead alloy, "soft lead" (low antimony lead) is smelted in reverberatory furnaces. Source materials include discarded batteries, lead residues, scrap lead, and, in the case of lead alloy, recycled secondary lead emissions control dust. The smelting processes take place at high temperatures. The soft lead is then further processed to either refined lead or lead oxide (USEPA 1980).

When reverberatory furnace emissions are scrubbed, cadmium, chromium, and lead entrained in the fumes are collected by either wet scrubbing or by baghouse. The emission control dusts collected by baghouse may be recycled for use as input material for lead alloy manufacture. Before the emission control dust is recycled to the remelt kettle, it is leached with dilute sulfuric acid to remove zinc. The waste leaching solution is the waste stream of concern, i.e., K100.(USEPA 1980).

Based on available information, the Agency believes that this waste is no longer generated by the lead smelting industry. However, K100 treatment standards are still necessary for application to residues from previous disposal.

WASTE CHARACTERIZATION

The Agency has determined that K100 represents a single treatability group based on its expected physical and chemical composition. This group consists of two subgroups -- wastewaters and nonwastewaters. For the purpose of the land disposal restrictions rule, wastewaters are defined as wastes containing less than 1 percent (weight basis) filterable solids and less than 1 percent (weight basis) total organic carbon (TOC). Wastes not meeting this definition are classified as nonwastewaters.

The Office of Water, Effluent Guidelines Division, draft development document (USEPA 1977) on the secondary lead smelting industry were reviewed. No characterization data were found on the K100 waste stream. Neither the EPA Preamble on Land Disposal Restrictions for First Third Scheduled Wastes: Final Rule (FR 31138-31222) nor the "Response to Comments Related to the First Third Wastes Treatment Technologies and Associated Performance" contains data on K100 waste and its treatability. The only characterization data available are in the Background Document for the listing of the waste (USEPA 1980).

*Table 1 K100 - Waste Characterization Data

BDAT constituents	Estimated concentration (mg/l)
Hexavalent chromium	20
Lead	60
Cadmium	110

Source: USEPA 1985.
*It should be noted that these are "synthetic waste" data based on emission control dust composition data and solubility of dust metal constituents in dilute sulfuric acid.

APPLICABLE AND DEMONSTRATED TREATMENT TECHNOLOGIES

This section describes the applicable treatment technologies for the treatment of K100 waste. The Agency identified the applicable treatment technologies based on the estimated waste composition (see Table 1). The technologies considered to be applicable are those designed to (1) Reduce the concentration of BDAT list metals present in the treated residual and/or (2) Reduce the leachability of BDAT list metals in the treated residual.

Chemical precipitation followed by dewatering of the precipitated solids is an applicable technology for the removal of the dissolved metals from K100 wastewater. Ordinarily, ion exchange would be an applicable technology. However, K100 is likely to have a very high ionic strength since it is derived from acid leaching. Ion exchange is not conducive to solutions with very high ionic strengths. Additionally, the presence of hexavalent chromium indicates the need for chromium reduction to convert hexavalent chromium to trivalent chromium prior to precipitation. Other applicable technologies include physical treatment methods that remove suspended solids from wastewaters (such as clarification, floccutation, vacuum filtration, sludge thickening, and other similar technologies).

Dewatering of the precipitated solids results in a nonwastewater filter cake stream and a wastewater filtrate stream. The filtrate may be further processed by polishing filtration, such as multimedia filtration, to remove the remaining suspended solids. For the nonwastewater solids that are precipitated and filtered, stabilization can be used to reduce the leachability of the BDAT list metals. Hexavalent chromium reduction followed by settling, filtering, and dewatering of solids are widely practiced metals treatment technologies (USEPA 1986a). Physical separation methods such as clarification, flocculation, filteration, and sludge thickening are also demonstrated treatment technology for removal of metals from wastewater.

All of the applicable technologies are demonstrated. Hexavalent chromium reduction, chemical precipitation, and dewatering by settling and/or filtration are widely practiced as a metals treatment technology for aqueous wastes. In addition, polishing filtration is a well-documented technology for removing insoluble material from wastewater streams. Regarding treatment of the precipitated solids, stabilization of wastewater treatment sludges is considered demonstrated.

PERFORMANCE DATA

In the absence of specific data on treatability of K100 wastes, EPA is promulgating concentration-based treatment standards for wastewater forms of K100 based on the transfer of performance data for treatment train of chromium reduction followed by metals precipitation, clarification, and sludge dewatering for K062 wastewaters. For the nonwastewater forms of K100, the Agency is promulgating treatment standards based on the performance of stabilization for F006 wastes.

A. Wastewaters. The Agency has 11 data sets for treatment of K062 wastewaters containing hexavalent chromium, lead, and cadmium by the treatment methods of hexavalent chromium reduction, chemical precipitation, and dewatering of the precipitate. These data are presented in Tables 2 through 12. These metal bearing wastewaters include waste code K062, and these data were previously used in the development of treatment standards for K062 in the First Third Final Rule (USEPA 1988b). The Agency believes that these K062 data can be used to assess the performance of these technologies for K100 wastewaters, since the untreated K062 wastewaters contain much higher concentrations for most metals than K100 wastewaters are expected to contain. Accordingly, EPA is using three performance data for treatment by hexavalent chromium reduction, chemical precipitation, and dewatering of the precipitate to promulgate treatment standards for cadmium and total chromium in K100 wastewaters.

The Agency has data indicating that K100 wastewaters may contain higher concentrations of lead than is typically found in K062 wastewaters. Therefore, the Agency evaluated available wastewater data for treatment of lead. The Agency evaluated the 15 data sets for treatment of D008 (lead) wastewaters from the foundry industry (Tischler/Kocurek - LD12-00027). These treatment performance data are presented in Table 13 and 14. The D008 wastewaters are generated from the emission control scrubber from the production of iron castings and are treated by a system consisting of chemical precipitation, flocculation, clarification, filtration, and sludge thickening.

EPA evaluated the D008 data with respect to characteristics that effect treatment performance. Specifically, the D008 data were determined to be similar to K100 wastewaters in terms of the concentration of lead. In fact, the D008 had higher untreated lead concentrations than K100 wastewaters, 50-276 mg/l compared to 60 mg/l). Also, the D008 waste lead concentration was substantially reduced (from as high as 276 mg/l of lead in influent to as low as 0.17 mg/l of lead effluent) by the treatment consisting of chemical precipitation, flocculation, clarification, filteration, and sludge thickening. The performance data for the D008 waste is shown in Table 14. Based on these D008 data the Agency would expect that these D008 wastewaters would be more difficult to treat than K100 wastewaters. Therefore, the Agency is using D008 treatment data to assess the performance of lead in K100 wastewater.

B. **Nonwastewaters**. Performance data are available for stabilization of F006 and K061 nonwastewaters using various pozzolonic binders and mix ratios. The data presented in Table 13 represent performance data developed from stabilization of F006 waste, while the data in Table 14 represent performance data of K061 wastes. These data were previously used in the development of treatment standards for F006 and K061 in the First Third Final Rule (USEPA 1988a,c).

Table 2 Treatment Performance Data for K062 - EPA-Collected Data

Sample Set #1

Constituent	Untreated K062 waste (mg/l) Sample No. 801	Untreated K062 waste (mg/l) Sample No. 802	Untreated waste composite[a] (mg/l) Sample No. 805	Treated waste (wastewater) (mg/l) Sample No. 806
Arsenic	3	<1	<1	<0.1
Cadmium	<5	<5	13	<0.5
Chromium (hexavalent)	I	I	893	0.011
Chromium (total)	1800	7000	2581	0.12
Copper	865	306	138	0.21
Lead	<10	<10	64	<0.01
Nickel	3200	2600	471	0.33
Zinc	<2	<2	116	0.125

Design and Operating Data

	Design value	Operating value
pH	8-10	9

I = Color interference.

[a] The untreated waste composite is a mixture of the untreated K062 waste streams shown on this table, along with other non-K062 waste streams.

Source: USEPA 1988b.

Table 3 Treatment Performance Data for K062 - EPA-Collected Data

Sample Set #2

Constituent	Untreated K062 waste (mg/l) Sample No. 801	Untreated K062 waste (mg/l) Sample No. 802	Untreated waste composite[a] (mg/l) Sample No. 813	Treated waste (wastewater) (mg/l) Sample No. 814
Arsenic	3	<1	<1	<0.1
Cadmium	<5	<5	10	<0.5
Chromium (hexavalent)	I	I	807	0.12
Chromium (total)	1800	7000	2279	0.19
Copper	865	306	133	0.15
Lead	<10	<10	54	<0.01
Nickel	3200	2600	470	0.33
Zinc	<2	<2	4	0.115

Design and Operating Data

	Design value	Operating value
pH	8-10	9

I = Color interference.

[a] The untreated waste composite is a mixture of the untreated K062 waste streams shown on this table, along with other non-K062 waste streams.

Source: USEPA 1988b.

Table 4 Treatment Performance Data for K062 - EPA-Collected Data

Sample Set #3

Constituent	Untreated K062 waste (mg/l) Sample No. 817	Untreated K062 waste (mg/l) Sample No. 802	Untreated waste composite[a] (mg/l) Sample No. 821	Treated waste (wastewater) (mg/l) Sample No. 822
Arsenic	3	<1	<1	<0.1
Cadmium	<5	<5	5	<0.5
Chromium (hexavalent)	I	I	775	I
Chromium (total)	1700	7000	1990	0.20
Copper	425	306	133	0.21
Lead	<10	<10	<10	<0.01
Nickel	100310	2600	16330	0.33
Zinc	7	<2	3.9	0.140

Design and Operating Data

	Design value	Operating value
pH	8-10	10

I = Color interference.

[a] The untreated waste composite is a mixture of the untreated K062 waste streams shown on this table, along with other non-K062 waste streams.

Source: USEPA 1988b.

Table 5 Treatment Performance Data for K062 - EPA-Collected Data

Sample Set #4

Constituent	Untreated K062 waste (mg/l) Sample No. 827	Untreated K062 waste (mg/l) Sample No. 802	Untreated K062 waste (mg/l) Sample No. 817	Untreated waste composite[a] (mg/l) Sample No. 829	Treated waste (wastewater) (mg/l) Sample No. 830
Arsenic	2	<1	3	<1	<1
Cadmium	<5	<5	5	<5	<0.5
Chromium (hexavalent)	1	I	I	0.6	0.042
Chromium (total)	142	7000	1700	556	0.10
Copper	42	306	425	88	0.07
Lead	<10	<10	<10	<10	<0.01
Nickel	650	2600	41000	6610	0.33
Zinc	3	<2	7	84	1.62

Design and Operating Data

	Design value	Operating value
pH	8-10	9

I = Color interference.

[a] The untreated waste composite is a mixture of the untreated K062 waste streams shown on this table, along with other non-K062 waste streams.

Source: USEPA 1988b.

Table 6 Treatment Performance Data for K062 - EPA-Collected Data

Sample Set #5

Constituent	Untreated K062 waste (mg/l) Sample No. 801	Untreated K062 waste (mg/l) Sample No. 802	Untreated K062 waste (mg/l) Sample No. 817	Untreated waste composite[a] (mg/l) Sample No. 837	Treated waste (wastewater) (mg/l) Sample No. 838
Arsenic	3	<1	3	<1	<0.1
Cadmium	<5	<5	5	<5	<0.5
Chromium (hexavalent)	I	I	I	917	0.058
Chromium (total)	1800	7000	1700	2236	0.11
Copper	865	306	425	91	0.14
Lead	<10	<10	<10	18	0.01
Nickel	3200	2600	41000	1414	0.31
Zinc	<2	<2	7	71	0.125

Design and Operating Data

	Design value	Operating value
pH	8-10	8

I = Color interference.

[a] The untreated waste composite is a mixture of the untreated K062 waste streams shown on this table, along with other non-K062 waste streams.

Source: USEPA 1988b.

Table 7 Treatment Performance Data for K062 - EPA-Collected Data

Sample Set #6

Constituent	Untreated K062 waste (mg/l) Sample No. 801	Untreated K062 waste (mg/l) Sample No. 802	Untreated waste composite[a] (mg/l) Sample No. 845	Treated waste (wastewater) (mg/l) Sample No. 846
Arsenic	3	<1	<1	<0.1
Cadmium	<5	<5	<5	<0.5
Chromium (hexavalent)	I	I	734	I
Chromium (total)	1800	7000	2548	0.10
Copper	865	306	149	0.12
Lead	<10	<10	<10	<0.01
Nickel	3200	2600	588	0.33
Zinc	<2	<2	4	0.095

Design and Operating Data

	Design value	Operating value
pH	8-10	8

I = Color interference.

[a] The untreated waste composite is a mixture of the untreated K062 waste streams shown on this table, along with other non-K062 waste streams.

Source: USEPA 1988b.

Table 8 Treatment Performance Data for K062 - EPA-Collected Data

Sample Set #7

Constituent	Untreated K062 waste (mg/l) Sample No. 801	Untreated K062 waste (mg/l) Sample No. 802	Untreated waste composite[a] (mg/l) Sample No. 853	Treated waste (wastewater) (mg/l) Sample No. 854
Arsenic	3	<1	<1	<0.1
Cadmium	<5	<5	10	<0.5
Chromium (hexavalent)	I	I	769	0.12
Chromium (total)	1800	7000	2314	0.12
Copper	865	306	72	0.16
Lead	<10	<10	108	<0.01
Nickel	3200	2600	426	0.40
Zinc	<2	<2	171	0.115

Design and Operating Data

	Design value	Operating value
pH	8-10	9

I = Color interference.

[a] The untreated waste composite is a mixture of the untreated K062 waste streams shown on this table, along with other non-K062 waste streams.

Source: USEPA 1988b.

Table 9 Treatment Performance Data for K062 - EPA-Collected Data

Sample Set #8

Constituent	Untreated K062 waste (mg/l) Sample No. 859	Untreated K062 waste (mg/l) Sample No. 801	Untreated waste composite[a] (mg/l) Sample No. 861	Treated waste (wastewater) (mg/l) Sample No. 862
Arsenic	<1	3	<1	<0.1
Cadmium	<5	<5	<5	<0.5
Chromium (hexavalent)	0.220	I	0.13	<0.01
Chromium (total)	15	1800	831	0.15
Copper	151	865	217	0.16
Lead	<10	<10	212	<0.01
Nickel	90	3200	669	0.36
Zinc	7	9	151	0.13

Design and Operating Data

	Design value	Operating value
pH	8-10	9

I = Color interference.

[a] The untreated waste composite is a mixture of the untreated K062 waste streams shown on this table, along with other non-K062 waste streams.

Source: USEPA 1986b.

Table 10 Treatment Performance Data for K062 - EPA-Collected Data

Sample Set #9

Constituent	Untreated K062 waste (mg/l) Sample No. 867	Untreated K062 waste (mg/l) Sample No. 801	Untreated K062 waste (mg/l) Sample No. 802	Untreated waste composite[a] (mg/l) Sample No. 869	Treated waste (wastewater) (mg/l) Sample No. 870
Arsenic	<0.1	3	<1	<1	<0.1
Cadmium	<0.5	<5	<5	<5	<0.5
Chromium (hexavalent)	0.079	I	I	0.07	0.041
Chromium (total)	6	1800	7000	930	0.10
Copper	5	865	306	225	0.08
Lead	<1	<10	<10	<10	<0.01
Nickel	4	3200	2600	940	0.33
Zinc	0.4	<2	<2	5	0.06

Design and Operating Data

	Design value	Operating value
pH	8-10	10

I = Color interference.

[a] The untreated waste composite is a mixture of the untreated K062 waste streams shown on this table, along with other non-K062 waste streams.

Source: USEPA 1988b.

Table 11 Treatment Performance Data for K062 - EPA-Collected Data

Sample Set #10

Constituent	Untreated K062 waste (mg/l) Sample No. 801	Untreated waste composite[a] (mg/l) Sample No. 885	Treated waste (wastewater) (mg/l) Sample No. 862
Arsenic	<3	<1	<0.10
Cadmium	<5	<5	<0.5
Chromium (hexavalent)	I	0.08	0.106
Chromium (total)	1800	395	0.12
Copper	865	191	0.14
Lead	<10	<10	<0.01
Nickel	3200	712	0.33
Zinc	<2	5	0.070

Design and Operating Data

	Design value	Operating value
pH	8-10	9

I = Color interference.

[a] The untreated waste composite is a mixture of the untreated K062 waste streams shown on this table, along with other non-K062 waste streams.

Source: USEPA 1988b.

Table 12 Treatment Performance Data for K062 - EPA-Collected Data

Sample Set #11

Constituent	Untreated K062 waste (mg/l) Sample No. 801	Untreated K062 waste (mg/l) Sample No. 859	Untreated waste composite[a] (mg/l) Sample No. 893	Treated waste (wastewater) (mg/l) Sample No. 894
Arsenic	3	<1	<1	<0.10
Cadmium	<5	<5	23	<5
Chromium (hexavalent)	I	0.220	0.30	<0.01
Chromium (total)	1800	15	617	0.18
Copper	865	151	137	0.24
Lead	<10	<10	136	<0.01
Nickel	3200	90	382	0.39
Zinc	<2	7	135	0.100

Design and Operating Data

	Design value	Operating value
pH	8-10	9

I = Color interference.

[a] The untreated waste composite is a mixture of the untreated K062 waste streams shown on this table, along with other non-K062 waste streams.

Source: USEPA 1986b.

Table 13 Treatment Performance Data for Stabilization of F006 Wastewater[a]

Source	Mix ratio[b]	Metal concentrations (ppm)							
		Barium	Cadmium	Chromium	Copper	Lead	Nickel	Silver	Zinc
Unknown									
Unstabilized									
As received	-	-	-	-	-	-	435	-	1560
TCLP	-	-	-	-	-	-	0.71	-	0.16
Stabilized									
TCLP	0.2	-	-	-	-	-	0.05	-	0.03
Auto part manufacturing									
Unstabilized									
As received	-	-	31.3	755	7030	409	989	6.62	4020
TCLP	-	-	2.21	0.76	638	10.7	22.7	0.14	219
Stabilized									
TCLP	0.5	-	0.01	0.45	0.27	0.39	0.03	0.06	0.01
Aircraft overhauling									
Unstabilized									
As received	-	85.5	67.3	716	-	-	259	-	631
TCLP	-	1.41	1.13	0.43	-	-	1.1	-	5.41
Stabilized									
TCLP	0.2	0.34	0.06	0.09	-	-	0.27	-	0.03
Zinc plating									
Unstabilized									
As received	-	17.2	1.30	-	1510	-	37	9.05	90,200
TCLP	-	0.84	0.22	-	4.6	-	0.52	0.16	2050
Stabilized									
TCLP	0.5	0.25	0.01	-	0.21	-	0.02	0.05	0.04
Unknown									
Unstabilized									
As received	-	14.3	720	12,200	160	-	701	-	25,900
TCLP	-	0.38	23.6	25.3	1.14	-	9.78	-	867
Stabilized									
TCLP	0.5	0.21	0.01	0.44	0.31	-	0.04	-	0.03

Table 13 (continued)

Source	Mix ratio[a]	Metal concentrations (ppm)							
		Barium	Cadmium	Chromium	Copper	Lead	Nickel	Silver	Zinc
Small engine manufacturing									
Unstabilized									
As received	-	-	7.28	3100	1220	113	19,400	4.08	27,800
TCLP	-	-	0.3	38.7	31.7	3.37	730	0.12	1200
Stabilized									
TCLP	0.5	-	0.01	0.89	0.31	0.39	0.06	0.06	0.040
Circuit board manufacturing									
Unstabilized									
As received	-	-	5.39	42,900	10,600	156	13,000	-	120
TCLP	-	-	0.60	360	8.69	1.0	152	-	0.62
Stabilized									
TCLP	0.5	-	0.01	1.41	0.45	0.41	0.11	-	0.020
Unknown									
Unstabilized									
As received	-	15.3	5.81	-	17,600	169	23,700	8.11	15,700
TCLP	-	0.53	0.18	-	483	4.22	644	0.31	650
Stabilized									
TCLP	0.5	0.294	0.01	-	0.35	0.40	0.04	0.06	0.020
Unknown									
Unstabilized									
As received	-	19.2	-	-	27,400	24,500	5,730	-	322
TCLP	-	0.28	-	-	16.9	50.2	16.1	-	1.29
Stabilized									
TCLP	0.5	0.087	-	-	0.50	0.29	<0.02	-	<0.01

[a]Adjusted analytical results (referred to as accuracy-corrected concentrations) used for comparing the performance of one technology to that of another and for calculating treatment standards for those constituents to be regulated (USEPA 1988a).

[b] Mix ratio = $\frac{\text{weight of reagent}}{\text{weight of waste}}$

Source: USEPA 1988a.

Table 14 Treatment Performance Data for D008 Wastewater

Sample set no.	Influent concentration (mg/l)	Effluent concentration (mg/l)[1]
1	66.7	0.17
2	91.7	0.25
3	83.3	0.25
4	276.0	0.33
5	50.0	0.17
6	50.0	0.25
7	58.3	0.33
8	58.3	0.33
9	134.0	0.33
10	200.0	0.25
11	100.0	0.33
12	116.0	0.25
13	91.7	0.33
14	100.0	0.42
15	116.0	0.33

[1] Recovery data 115 percent and 112 percent. Analytical recovery data show two recovery values, 115 & 112 percent. Because both values exceeded 100%, the effluent data were not corrected to lower values, but are considered at the uncorrected value. (See Methodology Document May 89).

Source: Tischler/Kocurek (LD12-00027)

Table 15 Design and Operating Data for D008 Wastewater Treatment
Performance Data

Sample set no.	TSS (mg/l)	Flow (GPM)	pH[1]	pH[2]
1	<4	1300	8.9	8.8
2	<4	1285	9.2	9.2
3	<4	1291	9.2	9.3
4	<4	1274	9.0	9.2
5	<4	1296	9.1	9.2
6	<4	1285	8.8	8.8
7	<4	1305	9.1	9.2
8	<4	1295	9.2	9.3
9	<4	1285	9.1	9.2
10	<4	1290	9.2	9.2
11	<4	1250	8.7	8.5
12	<4	1250	8.6	8.6
13	4	1300	8.8	8.8
14	5	1262	9.2	9.1
15	6	1307	9.4	9.2

Chemical addition:

Cationic polymer - 1.5 ppm
Anionic polymer - 0.5 ppm
16 percent high magnesium lime - 4.26 GPM

[1] pH of recycle to clarifier.
[2] pH in clarifier.

Source: Tischler/Kocurek (LD12-00027)

Table 16 Summary of Treatment Performance Data for Stabilization of K061 Nonwastewater Using a Lime/Flyash Binder (EPA Collected Data)

Constituents	Untreated waste Total (ppm)	Untreated waste TCLP (mg/l)	Treated waste TCLP (mg/l)
Antimony	294	0.040	<0.050
Arsenic	36	<0.010	<0.010
Barium	238	0.733	0.431 - 0.500
Beryllium	0.15	<0.001	<0.001
Cadmium	481	12.8	0.033 - 0.073
Chromium	1,370	<0.007	0.053 - 0.093
Copper	2,240	0.066	<0.004 - 0.015
Lead	20,300	45.1	0.066 - 0.150
Mercury	3.8	0.0026	0.0016 - 0.0018
Nickel	243	0.027	<0.012
Selenium	<5.0	<0.050	<0.025
Silver	59	0.021	<0.003
Thallium	<1.0	0.038	0.011 - 0.014
Vanadium	25	<0.006	0.080 - 0.089
Zinc	244,000	445	0.179 - 0.592
Oil and grease	282		
Sulfates	8,440		
Chlorides	19,300		
TOC	4,430		

Source: USEPA 1988c.

DETERMINATION OF BEST DEMONSTRATED AVAILABLE TECHNOLOGY (BDAT)

This section presents the rationale for the determination of best demonstrated available technology (BDAT) for nonwastewater and wastewater forms of K100. The Agency examined all the available treatment performance data for the demonstrated technologies to determine which is best. Treatment performance data are available for metal bearing wastewaters containing K062 and D008 waste that is believed to be similar in its metal constituents and physical form, but K062 has several BDAT list metals at higher concentrations than K100 wastewaters to K100 wastewaters. For K100 nonwastewaters, performance data are available from stabilization tests on F006 and K061 nonwastewaters.

A. Wastewater. Available treatment performance data presented in Tables 2-12 for treatment of K062 wastewaters by chromium reduction, chemical precipitation, and filtration show that this treatment is effective. Total chromium was reduced from 2,581 mg/l to 0.12 mg/l; cadmium from 13 mg/l to <0.5 mg/l; nickel from 471 mg/l to 0.33; and lead from 64 mg/l to <0.01 mg/l. The Agency has determined that the data collected from treatment of K062 wastewaters represent a well-designed and well-operated system and therefore may be used to compare treatment performance of demonstrated technologies.

The Agency believes that K062 wastewater data transfer is technically feasible since, K062 wastewater best represents a K100 wastewater due to the concentration of its metal constituents (i.e., up to 917 mg/l in K062 wastewater compared to the anticipated 20 mg/l of hexavalent chromium in K100). Also, the Agency recognizes that chemical precipitation is a well-established method for removal of cadmium from wastewaters (USEPA 1986a).

Based on the evaluation of the available treatment performance data and other information, the Agency believes that the treatment train consisting of hexavalent chromium reduction, chemical precipitation, and settling and/or filtration represents BDAT for chromium and cadmium in K100 wastewaters.

Even though K062 data could be used to evaluate treatment of lead in K069 wastewaters, treatment data for K062 wastewaters, however, were not used because during the Third Third comment period, EPA received D008 (lead) wastewater data (Tischler/Kocurek; LG 12-00027) showing higher lead concentration in untreated D008 waste in both K100 and K062. These data are shown in Table 14. D008 treatment data (15 data sets) showed, treatment was possible to 0.17-0.42 mg/l for lead. Since D008 wastewater data have higher untreated lead concentration than both K062 and K100 wastewaters (i.e., D008 should be more difficult to treat than either K100 or K062), EPA is using these data to calculate the treatment standard for lead (see Table 18). The D008 data were collected from a well-designed and well-operated treatment system consisting of chemical precipitation, flocculation, clarification, filtration, and sludge thickening. Also, submitted for D008 treatment were effluent values without the corresponding untreated data. These data could not be used in EPA's evaluation of the treatment system. However, they are presented in Appendix A.

The Agency believes that the D008 wastewater treatment data for chemical precipitation, flocculation, clarification, filtration, and sludge thickening represents BDAT for lead in K069 wastewaters. The treatment performance data demonstrate substantial reduction of the concentration of lead in wastewaters from levels as high as 276 mg/l to as low as 0.17 mg/l; (see Table 14). Therefore, the Agency is transferring the D008 wastewater treatment performance data for lead to K069 wastewaters, with the above-mentioned treatment train representing BDAT for lead in K069 wastewaters.

For chromium and cadmium in K100 wastewater, the treatment standard is based on the performance hexavalent chromium reduction, chemical precipitation for K062 wastewaters. For lead, in K100 wastewater the treatment standard is also based on the performance of chemical precipitation, but in D008 wastewaters. As noted above, the Agency believes the D008 wastewaters better represent lead treatment in K100 wastewaters. Since both the K062 and D008 treatment trains use the same technology (i.e., precipitation) as a method of removing metals from wastewaters, EPA believes that the use of K062 wastewater data for cadmium and chromium in K100 wastewaters is compatible with the use of D008 wastewater data for lead regulation in K069 wastewater.

Based on the evaluation of the available treatment performance data and other information, the Agency has determined that the treatment train consisting of hexavalent chromium reduction, chemical precipitation, filtration, clarification, and sludge dewatering is BDAT for K100 wastewater for treating cadmium, chromium, and lead.

B. Nonwastewaters. EPA compared the F006 wastes and K061 wastes with regard to metals concentrations. In general, both K061 nonwastewaters and F006 nonwastewaters contain similar metal constituents but F006 has several BDAT list metals at higher concentrations. Specifically, chromium is present in the untreated F006 wastes at concentrations as high as 42,900 ppm and in K061 wastes as high as 1,370 ppm; lead is present in F006 in concentrations as high as 24,500 ppm and in K061 wastes at 20,300 ppm; cadmium is present in F006 wastes at concentrations as high as 720 ppm and in K061 wastes as high as 481 ppm. Additional characterization of the wastes (USEPA 1988a,c) show that F006 wastes have higher concentrations of organics than K061, which would tend to make the F006 waste more difficult to treat by stabilization techniques based on waste characteristics that affect the stabilization process. Importantly, K100 nonwastewaters would be formed by chemical

CALCULATION OF BDAT TREATMENT STANDARDS

This section presents the treatment standards for the regulated constituents described previously. A description of the rationale and procedures for calculating treatment standards for wastewaters and nonwastewaters is presented in the K062, D008, and F006 background document ((1988a, 1988b) and the Background Document for D008, May 90). The BDAT treatment standards presented in this section are reflective of treatment performance data from a well-designed and well-operated treatment systems, and are adjusted for analytical accuracy.

A. Wastewaters. Treatment Standards for Cadmium and Chromium: EPA compared the K062 wastewaters and K100 waste stream shown in Table 1 with regard to concentrations of metals. In general, both K100 wastewaters and K062 wastewaters contain similar metal constituents. As noted earlier, K062 wastewaters have BDAT list metals at higher concentrations than do K100 wastewaters. Therefore, EPA would expect the K062 wastewaters to be more difficult to treat.

Further, based on the characteristics, the Agency has no reason to believe that for chromium and cadmium, the treatment levels achieved for K062 wastewaters cannot be achieved for K100 wastewaters. Accordingly, EPA is using the K062 wastewater performance data for hexavalent chromium reduction, chemical precipitation, and settling and/or filtration to establish treatment standards for chromium and cadmium K100 wastewaters. Therefore, the Agency is transferring the treatment performance data from the treatment train for K062 wastewaters to K100 wastewaters.

The 11 data sets for treatment of K062 wastewaters by hexavalent chromium reduction, chemical precipitation, and dewatering of the precipitate were determined to represent treatment by a well-designed and well-operated treatment system (USEPA 1988b). One treatment data set for

cadmium was rejected (Sample Set #11) because of an artificially high detection limit of 5 mg/l for chromium and cadmium, which deviated from the other 10 data points' detection limits of 0.5 mg/l. An expanded description of the calculation of these treatment standards is presented in the K062 background document (USEPA 1988b).

Treatment Standard for Lead. The 15 data sets for treatment of lead in D008 wastewaters by chemical precipitation, flocculation, clarification, filtration, and sludge thickening were determined to represent treatment by a well-designed and well-operated system. (See Table 14 and 15). The 15 effluent treatment points for lead were corrected for analytical recovery by multiplying the data by the appropriate correction factor. The correction factor was calculated from the recovery data submitted with the data for the treatment tests (Tischler/Kocurek 1989). Both of the recovery figures (115 and 112 percent) were greater than 100 percent. Therefore, a correction factor of 1.0 is used and the corrected values equal the original data value (see Methodology Document, May, 1989).

An arithmetic average of accuracy-corrected concentration levels for each regulated constituent and a variability factor for each regulated constituent were then calculated. The treatment standard for each regulated constituent was calculated by multiplying the average accuracy-corrected data by the appropriate variability factor. The calculation of the treatment standards for K069 wastewaters is presented in Table 21.

Table 20 presents the specific BDAT treatment standards for K100 wastewater. For the BDAT list metal constituents, treatment standards in the wastewater reflect the total constituent concentration. The units for the total constituent concentration are mg/l (parts per million on a

Table 15 Calculation of the Treatment Standards for the Regulated Constituents - Treated Wastewater

Regulated constituent (correction factor)	Average corrected concentration (mg/l)	Number of samples	Average	Variability factor	Treatment standard (mg/l)
Cadmium (1.15)	<0.575	10	0.575	2.8[a]	1.61
	<0.575				
	<0.575				
	<0.575				
	<0.575				
	<0.575				
	<0.575				
	<0.575				
	<0.575				
Chromium (total) (1.47)	0.1765	11	.1898	1.69	0.32
	0.1765				
	0.2941				
	0.1471				
	0.1618				
	0.1471				
	0.1765				
	0.2206				
	0.1471				
	0.1765				
	0.2647				
Lead (1.316)	<0.0132	11	0.0132	2.8[a]	0.04
	<0.0132				
	<0.0132				
	<0.0132				
	0.0132				
	<0.0132				
	<0.0132				
	<0.0132				
	<0.0132				
	<0.0132				
	<0.0132				

[a]For cases in which all values are at or below the detection limit, the variability factor is taken as 2.8.

weight-by-volume basis) for the wastewater. If the concentrations of the regulated constituents in the K069, as generated, are lower than or equal to those of the BDAT treatment standards, then treatment is not necessary as a prerequisite to land disposal.

B. Nonwastewaters. Specifically, EPA believes that the data on stabilization of F006 waste can be used to assess treatment performance for chromium, cadmium, and lead in K100 nonwastewaters, since significant treatment occurred for the regulated constituents (i.e., from 23.6 TCLP untreated to 0.01 ppm TCLP for cadmium; and from 360 ppm TCLP untreated to 1.61 ppm TCLP for chromium; and from 50.2 ppm TCLP untreated to 0.29 ppm TCLP for lead).

The data presented for stabilization of F006 nonwastewaters (see Table 13) have been evaluated by EPA to ensure that any data representing poor design and poor operation were deleted and that all data were adjusted for analytical accuracy. Using the accuracy corrected data, EPA developed treatment standards by averaging the performance data for each constituent and then multiplying the average value by a variability factor that accounts for variations in technology performance, waste characteristics, and laboratory analysis. An expanded description of the calculation of these treatment standards is presented in the F006 background document.

Table 18 shows the calculations for the three metals regulated for K100 nonwastewaters. For the BDAT list metal constituents, treatment standards in nonwastewater reflect the concentration of constituents in the leachate from the Toxicity Characteristic Leaching Procedure (TCLP). The units for the leachate concentration are mg/l (parts per million on a weight-by-volume basis). If the concentrations of the regulated constituents in K100 TCLP leachate, as generated, are lower than or equal to the limits set by the BDAT treatment standards, then treatment is not necessary as a prerequisite to land disposal.

Table 17 Calculation of Corrected Values for Regulated Constituents for Treated Wastewater

Constituent	Treated waste[d] (mg/l)	Percent recovery	Correction factor	Corrected value (mg/l)
Cadmium	<0.5	87[a]	1.15	<0.575
	<0.5			<0.575
	<0.5			<0.575
	<0.5			<0.575
	<0.5			<0.575
	<0.5			<0.575
	<0.5			<0.575
	<0.5			<0.575
	<0.5			<0.575
	<0.5			<0.575
Chromium (total)	0.12	68[a]	1.47	0.1764
	0.12			0.1764
	0.20			0.294
	0.10			0.147
	0.11			0.162
	0.10			0.147
	0.12			0.1764
	0.15			0.2205
	0.10			0.147
	0.12			0.1764
	0.18			0.2646
Lead	0.17	115[b]	1.00[c]	0.17
	0.25			0.25
	0.25			0.25
	0.33			0.33
	0.17			0.17
	0.25			0.25
	0.33			0.33
	0.33			0.33
	0.33			0.33
	0.25			0.25
	0.33			0.33
	0.25			0.25
	0.33			0.33
	0.42			0.42
	0.33			0.33

[a] The percent recovery has been taken from Table 7-14 of the Onsite Engineering Report for Horsehead Resource Development Co., Inc. for K061 (USEPA 1987).

[b] The percent recovery for lead is from the D008 data submitted by Tischler/Kocurek (LD12-00027).

[c] For recoveries greater than 100, a correction factor of 1.00 is used and the corrected values equal the uncorrected data.

[d] Data for cadmium from USEPA 1988b; data for lead from Fischler/Kocurek (LD12-00027); data for lead from USEPA 1988b.

Table 18 Calculation of the Treatment Standards for the Regulated Constituents for Treated Wastewater

Regulated constituent	Conc.	Mean	VF	Treatment standard total concentration (mg/l)
Cadmium	<0.575	0.575	2.8[a]	1.61
	<0.575			
	<0.575			
	<0.575			
	<0.575			
	<0.575			
	<0.575			
	<0.575			
	<0.575			
	<0.575			
Chromium (total)	0.1765	0.1898	1.69	0.32
	0.1765			
	0.2941			
	0.1471			
	0.1618			
	0.1471			
	0.1765			
	0.2206			
	0.1471			
	0.1765			
	0.2647			
Lead	0.17	0.288	1.76	0.51
	0.25			
	0.25			
	0.33			
	0.17			
	0.25			
	0.33			
	0.33			
	0.33			
	0.25			
	0.33			
	0.25			
	0.33			
	0.42			
	0.33			

[a] For cases in which all values are at or below the detection limit, the variability factor is taken as 2.8.

Table 19 Calculation of the Treatment Standards for the Regulated Constituents -- Treated Nonwastewater

	Cadmium	Chromium	Lead
Concentration (mg/l)	0.01	0.45	0.39
	0.06	0.09	0.39
	0.01	0.44	0.41
	0.01	0.89	0.40
	0.01	1.41	0.29
	0.01		
	0.01		
Average	0.018	0.66	0.37
Number of samples	7	5	5
Variability factor	3.72	7.94	1.37
Treatment standard (mg/l)	0.066	5.2	0.51

Source: USEPA. 1988a.

Table 20 BDAT Treatment Standards for K100
[Wastewaters]
(Revised from No Land Disposal)

Regulated Constituent	Maximum for any Single Grab Sample Total Composition (mg/l)
Cadmium	1.61
Chromium (Total)	0.32
Lead	0.51

Table 21 BDAT Treatment Standards for K100
[Nonwastewaters]
(Revised from No Land Disposal)

Regulated Constituent	Maximum for any Single Grab Sample Total Composition (mg/l)
Cadmium	0.066
Chromium (Total)	5.2
Lead	0.51

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APPENDIX A

Appendix A

Tischler/Kocurek Effluent Data

Date	Lead (mg/l)	Date	Lead (mg/l)
11/88	2.0	6/89	0.4
	0.1		0.3
	0.3		0.4
	0.1		0.4
	0.1		
		7/89	0.2
12/88	0.2		<0.001
	0.2		
1/89	0.3	8/89	0.2
	0.7		0.2
	0.2		0.6
	0.2		0.4
	0.4		
		9/89	0.3
2/89	0.4		0.4
	0.4		0.4
	0.2		
		10/89	0.3
	0.6		0.4
	0.3		0.2
	0.4		0.4
			0.2
4/89	0.2		
	0.3	11/89	0.1
	0.3		0.2
	0.3		0.2
5/89	0.3		
	0.2		
	0.1		
	0.4		
	0.3		

Reference: Tischler/Kocurek (LD12-00027)